IMPACT OF 5G RAN ARCHITECTURE IN TRANSPORT NETWORKS

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OND M 2018 – Optical Technologies in the 5G era (Workshop)

Bristol 5G city testbed with 5G-XHaul extensions
OUTLINE

- From 4G to 5G architecture
- The F1 interface and new RRC states
- The F2 interface (3GPP and eCPRI)
- 5G deployment options
- 5GXHAUL/5GPICTURE’s view on a converged 5G transport
- Thoughts on transport support for 5G QoS
- Conclusions
FROM 4G TO 5G ARCHITECTURE
F1 INTERFACE AND NEW RRC STATES

- **F1 functions:**
  - Mgmt CU-DU (discovery, reset, etc)
  - SIB delivery from CU to DU
  - UE context mgmt: F1 sessions maintained per UE

- Non-Real time
  - SDAP
  - RRC
  - PDCP

- Real time
  - F1
    - SDAP
    - RRC
    - PDCP
  - Real time
    - SDAP
    - RRC
    - PDCP

- Non-3GPP
  - Xw
    - WT
    - 802.11
F1 INTERFACE AND NEW RRC STATES

AMF

N2

N2

Xn

F1

F1

F1

gNB-CU

gNB-CU

gNB-DU

gNB-DU

gNB-DU

UE RRC STATES

RRC Connected

N3: ESTABLISHED
F1: ESTABLISHED

RRC Idle

N3: RELEASED
F1: RELEASED

RRC Inactive

N3: ESTABLISHED
F1: RELEASED

Location kept by gNB-CU in terms of RNA (RAN Notification Areas)

intra-CU F1 handover

inter-CU F1 handover

UE
F2 INTERFACE (3GPP AND eCPRI)

- Not much progress inside 3GPP → Work in parallel carried out by eCPRI
- A variety of potential splits considered

![Diagram showing various eCPRI splits and their functionalities]
## F2 Requirements Summary

- From eCPRI spec
  - 3/1.5 Gbps user throughput
  - 500 PRBs
  - 8/4 DL/UL MIMO layers

- 64 Antennas
- Digital BF in eREC
- 256QAM
- IQ 30 bits/sample

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F2 INTERFACE SCALABILITY [1]

400G Ethernet (IEEE P802.3bs)

- supports all splits/RATs
- for 5G split E'/full centralization only a few cells can be aggregated in one link

10G Ethernet, ~CPRI rate 8

- can support only 4G, low load/split C, no support of 5G split E'/full centralization

(**) 5G-RAN target OWD delays: 4 ms eMBB, 0.5 ms URLLC
[1] Andy Sutton, BT, 5G Network Architecture, available at: https://www.youtube.com/watch?v=aGEAQJ7U1tA
5GXHAUL/5GPICTURE’S VIEW ON A MULTI-TENANT 5G TRANSPORT

**Data Plane**

- ETN (interface PNF/VNF) – IATNs (stich transport domains)
- Per-tenant state at the edge
- MACinMAC transport (pathID+sliceID)

**Control Plane**

- Hierarchical
- L0 – tech domain aware
- L1 – tech domain agnostic
- RAN – Transport interface
- Synch Harmonizer
THOUGHTS ON TRANSPORT SUPPORT TO 5G QoS

- F1, N3, Xn, Xw interfaces are all based on GTP
  - GTP TEID identifies per-UE sessions
  - GTP extension header will carry the 5G QoS Flow ID (QFI)
- Can we directly map 5G QoS to transport flows (at least at the edge)?
  - i.e. establish transport flows according to UE’s RRC transitions
- Analysis performed based on an operational LTE network in Greece (33 cells)

State maintained at each transport node

Signalling load with transport controller
SUMMARY AND CONCLUSIONS

- 5G RAN base station decomposed into RRH – DU – CU
- “Backhaul-like” F1 interface below PDCP between CU and DU
- Multiplicity of options (functional splits) between DU and RRH
- 5G’s flexibility provides built-in support for low latency applications within the network
Thanks for your attention!

Questions?